DOCUMENT RESUME

ED 219 287 SE 038 800

AUTHOR Canipe, Stephen L.
TITLE Biology and the Future of Man.
PUB DATE 82
NOTE 80p.

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Biological Influences; *Biology; *College Science; Demography; Environmental Education; *Environmental Influences; *Futures (of Society); Heredity; Higher Education; Instructional Materials; Pesticides; Radiation; Reproduction (Biology); Science Curriculum; Science Education; Secondary Education; *Secondary School Science; Units of Study; Wastes

ABSTRACT

The purpose of this unit is to provoke discussion and thought by the reader. Topics considered include cloning; amniocentesis and sex determination; predicting abnormalities and abortion; transplants; life prolonging machines; cryogenics; prenatal surgery; sperm and egg banks; radiation; psychobehavior, ESB (electrical stimulation of the brain), and mind altering drugs; euthanasia; inequalities in care; germ and biological warfare; machine technology; human experimentation; balanced populations; green revolution (agricultural changes which have taken place over the last 25 years); greenhouse effect; ozone; noise, sewage, metals, and solid waste; and pesticides. Two tests are included, one over the entire unit and another over the content presented in the first three sections. (Author/JN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED219287

biology and the future of man

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

✓ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

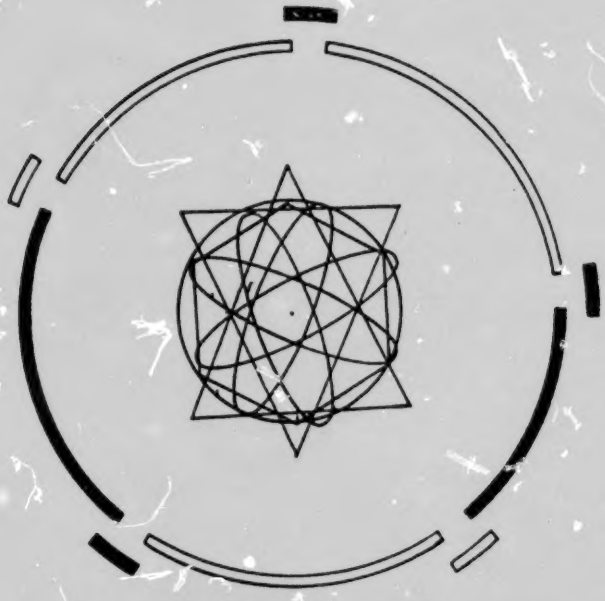
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Stephen L. Comja

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

SE 038 860

BIOLOGY and the FUTURE of MAN



BY: Stephen L. Canipe, Ed.I

INTRODUCTION

The purpose of this unit called BIOLOGY AND THE FUTURE OF MAN is to provoke discussion and thought by the reader. There are no answers presented and few questions left unasked, as they relate to the future.

Sections concerning all the current topics of interest are included in this unit. There are two test sections---one is the quiz on the entire unit the other is a quiz from the first three sections.

Questions concerning the materials should be directed to the author at the following address:

Dr. Stephen L. Canipe
P.O. Box 33189
Charlotte, NC 28242
704/373-4530

820910

TABLE OF CONTENTS

CLONING..... 1

AMNIOCENTESIS & SEX DETERMINATION..... 5

PREDICTING ABNORMALITIES & ABORTION..... 8

<TEST>.....12

TRANSPLANTS.....13

LIFE PROLONGING MACHINES.....17

CRYOGENICS.....23

PRENATAL SURGERY.....25

SPERM & EGG BANKS.....26

RADIATION.....27

PSYCHOBEHAVIOR, ESB, MIND ALTERING DRUGS.....31

EUTHANASIA.....34

INEQUALITIES IN CARE.....36

GERM & BIOLOGICAL WARFARE.....39

MACHINE TECHNOLOGY.....43

HUMAN EXPERIMENTATION.....45

BALANCED POPULATIONS.....47

GREEN REVOLUTION.....51

GREENHOUSE EFFECT.....55

OZONE.....58

NOISE, SEWAGE, METALS & SOLID WASTE.....62

PESTICIDES.....66

< FINAL TEST>.....70

TECHNOLOGY AND THE FUTURE OF MAN: CLONING

Normally, in sexually reproducing life forms, fertilization is followed by repeated mitotic nuclear divisions and accompanying cytoplasmic separations. This results in the development of a multicellular body (cells differentiating into tissues, etc.). However, the original DNA, being duplicated in this individual came half from each parent, so the genetic traits of the newly-formed individual will not be identical to either. If one is thinking in terms of human genetic recombination, there would be such a limitless number of possible combinations of traits to consider, that each individual could be though of as statistically unique. So, if a particular "good" combination of traits did occur, it would be a one-shot deal.

Imagine the possibilities if one could duplicate .. produce carbon copies of .. successful human individuals ... their exact genetic makeup.

As far back as 1891 it was demonstrated that the fertilized egg was not the only cell capable of developing into a fully formed individual. Dr. H. Driesch took sea urchin embroys, shook their cells apart, and noted that each one developed into a fully-formed sea urchin.

At Indiana University in the 1950's Drs. Briggs and King performed delicate surgery on frog's eggs, totally removing the nucleus. The nucleus contained all the frog's genetic instructions on how to continue to grow. They then replaced the nucleus with one removed from a cell of a different, more mature frog embroyo... and the newly-formed frog developed right along, just like nothing had happened. The frog produced was genetically identical to the one from which the nucleus had been taken.... it was a cloned

individual of a sort ... a genetically identical copy of a previously-existing living thing.

Subsequent experiments showed that nuclei could only be used in this work out of those cells that had not been allowed to mature too much. After development of the organism reached a certain point, it was found that genetic information begins to be used and "shut down" according to the ultimate fate of the cell in which it is found. Still later experiments showed that in some vertebrate animals (another type of frog, work by Dr. J. B. Gurdon) cells such as those from the lining of the intestine could yield a nucleus that would give all necessary directions to an enucleated cell.

It is believed that in a fullgrown, mature organism every cell .. no matter how different it might be in form the genetic data transmitted from the original fertilized egg The problem, in the 1960's then, seemed to be the unmasking of this information for use again in direction of a new cell's work. If cells could be induced to "shed their inhibitions," couldn't we then grow another whole organism all over from any cell taken from part of the body?

At Cornell University, Dr. F. S. Steward began a series of experiments using mature, differentiated cells from roots, stems and leaves of carrots and tobacco plants grown in liquid suspensions. Single cells isolated from such tissues produced clones; in the case of tobacco, just lumps of cells, but in carrots .. tiny heart-shaped carrot embryos. These clones could eventually be transferred to soil, given the proper nutrients, and allowed to develop again into identical, whole carrot plants.

It's a long way from carrots and frogs to man, granted, but transitional work in overcoming technical difficulties involved in cloning human cells was begun in the 1960's. Dr. J. Rostand noted then:

> "If a biologist takes a tiny fragment of tissue from a freshly dead body, he could make from it one of those cultures which we know to be immortal, and there is no absolute reason why we should not imagine the perfected science of the future as remaking from such a culture a complete person, strictly identical to the one who furnished the principle."

One of the technical problems in working with human cells is the actual size of the cell, for instance the fertilized egg. The largest mammal eggs are like those of the rabbit ... 1000 times smaller than the frog eggs already discussed. Human eggs have about 1/3 the volume of a rabbit's egg. Since 1969, however, micro-surgery equipment necessary to make nuclear transplants from cells as small as the human egg have been developed.

This advance, coupled with previous knowledge, leaves us now at a point from which according to some scientists, we could make as many identical copies of individuals as desired. In the future a living creature, even man, could be printed in hundreds, even thousands of copies, all genetically identical. (Could we, had this method been perfected, have undone the assassination of, say, President Kennedy? But it would have still taken a lifetime of years to produce a new JFK of the desired age) Dr. George Wald of Harvard University speaks of a recurring nightmare: He walks into Grand Central Station in New York and sees eight Albert Einsteins buying eight copies of the New York Times.

The future holds a possibility of sub-zero cell "banks" from which could be extracted material appropriate for cloning. Dr. Hayflick, a cancer researcher, reports already the ability to store and "revive" 6-year-old cells.

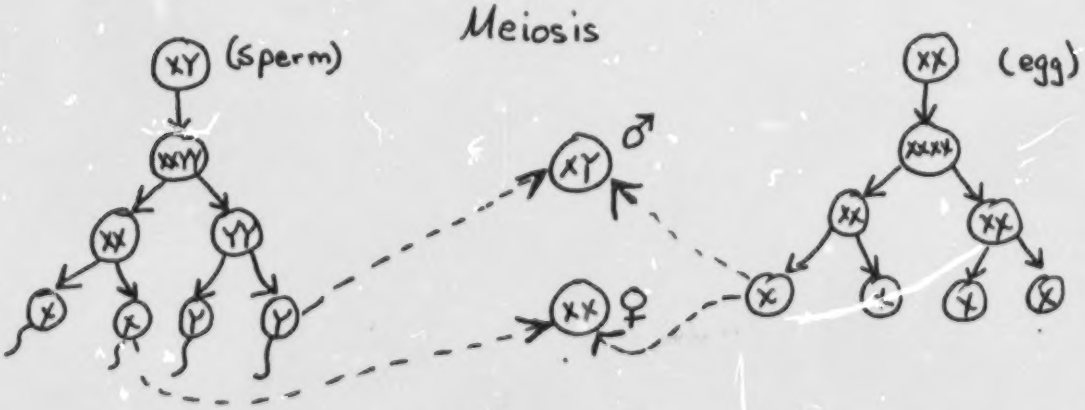
Would an individual produced from an Einstein cell be another Einsten? Even though the genetic information is the same, how much of Einstein's potential came from the environment in mother's womb.. how much from upbringing.. unduplicatable experiences of life?

Techniques exist... potential is there... and the future?

BIOLOGY AND THE FUTURE OF MAN: Amniocentesis & Sex Determination

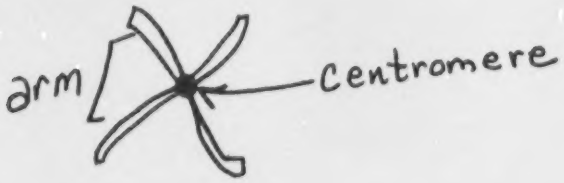
Amniocentesis is the process of extraction of a small amount of fluid from within the amnionic sac surrounding a developing human fetus. The extraction is done by carefully inserting a hypodermic syringe through mother's abdomen, uterine wall, and into space surrounding fetus. The fluid contains at least a small number of sloughed off (lost) fetal skin cells. These can be separated from the fluid itself and placed in a culture in such circumstances that the cells divide, then these cells are analyzed for their chromosome content. The analysis of chromosomes can lead to direct identification of many chromosomal abnormalities which are responsible for specific hereditary diseases. It can also reveal the sex of the fetus.

There are 2 types of sex chromosomes in humans. These control the development of physical sex-related characteristics. In the normal female there are among the 46 chromosomes in each cell, 2 X chromosomes. This makes her genetic makeup 44 autosomes (regular, nonsex-relted chromosomes) and 2X. Male's cells contain 44 autosomes and 1 X and 1 Y. It should be apparent, then, that the sex of the fetus is determined by the type of sex chromosomes contributed in sperm by the father.



In identification of chromosomal makeup after amniocentesis, cells are treated with a chemical, colchicine, which stops the mitotic division at a

stage involving the most compact replicated chromosomes, thereby allowing the best chance for observation and study. Replicated copies of chromosomes are held together at centromere and look like the diagram at right. Nuclear memberanes are absent and cell is stained with a chemical that is aborbed by



DNA. Then chromosomes are photographed through a high-power microscope. Chromosomes are cut apart in the picture and arranged in an order that best allows their comparison with normal patterns. This grouping process is called karyotyping. We have a lab that will allow you to experience the process of karyotyping.

Specifically, presence or absence of X's and Y's will tell the examiner the sex of the fetus. Other problems that can be detected include:

- presence of extra whole chromosomes in genome. This could result from improper separation of chromosomes during meiosis in parents.

45,2X or 45, XY will result in many physical and mental abnormalities, depending on which specific chromosome is present in an extra copy. If the extra chromosome is a member of the "D" group, the abnormality could be Down's Syndrome, which results in abnormal physical developmetn and retardation of the mental development to the extent that the individual would not surpass a mental age of 8 years.

Extra copies of many chromosomes will not allow the fetus to survive at all.

- absence of chromosomes. This could also result from improper separation of chromosomes during meiosis.

44, X results in what is called a Turner's syndrome female. This individual is often somewhat retarded and has particular physical abnormalities including decrease in secondary sex characteristics (breast size, height, body contours, functional ovaries).

- breakage of chromosomes resulting in loss of parts (deletions) and/or movement of chromoscme arms to abnormal locations (translocations).

This would result in abnormally long or short arms on chromosomes.

Deletion of parts of the $15 chromosome result in a severe hereditary abnormality claled cri du chat syndrome (cry of the cat). This problem results in some phsical abnormality but much internal abnormality in the structure of heart, liver, etc. Death at an early age is the result of this chromosomal problem.

There are about 80 hereditary diseases that have been tied to specific, visible changes in the normal human chromosomal arrangement. It is predicted that as time goes by more and more such situations should be identified. There is also indication that shortly there will be a much less risky method of identifying at least the sex of a fetus, perhaps even a simple urine test on the mother.

The implications for the future as to survival of individuals with hereditary abnormalities, identification of fetuses with abnormalities at an early time in a pregnancy, and prenatal determination of sex present us with some of the most difficult and personal decisions we face. What types of use should be made of the information that will become available from amniocentesis will affect the future of manking worldwide.

BIOLOGY AND THE FUTURE OF MAN: Prediction of hereditary abnormalities and abortion

In the future, the trend will be toward more and more information becoming available as prdiction of the occurrence of hereditary abnormalities. The possible alternatives available after the obtaining of such knowledge are also a problem with which we must deal. First, however, there must be some criteria used in the determination of a genetic abnormality. As far back as 1954 Neel and Schull presented a list of guidelines in the determination of hereditary diseases (as opposed to some environmentally produced or congenital problem):

1. The occurence of the disease in definite proportions among persons of relative descent and in which cases environmental factors can be ruled out.
2. The failure of the condition to appear in unrelated lines.
3. A greater occureence among identical than among fraternal twins.
4. A characteristic onset age and course without any identifiable cause.

Now and increasingly in the future it will be possible to add another test:

5. The presence in the individual of a characteristic abnormality and the physical demonstration of a corresponding abnormality in the chromosomes, whether anyone else in the family has the problem.

The field of genetic counseling is a growing area which is rising to meet the needs of people to understand hereditary problems ... and to determine alternative ways of dealing with them. Today, the role of the genetic counselor is restricted to assisting families which have produced a gentically defective child, who must make a decision about having more children or offspring from families previously known to contain genetically defective individuals. The counselor's role is to determine the recurrence

risk, interpret it to the concerned individuals and provide medical information about alternatives. Currently these alternatives are rather limited. The parents (or prospective parents) may decide to have no more children, to adopt, to undergo prenatal diagnosis (amniocentesis or some similar technique) during any future pregnancies, to consider artifical insemination, to terminate an existing pregnancy, to run whatever risk exists without further aid. Current techniques for doing these things include use of a family history... detailed chart showing relationships in family and occurrence of hereditary problem (see attachment), mass screening (such as PKU test for all babies) followed by counseling with identified carriers or affected individuals, notifying prospective parents of genetic incompatibilities (Rhogam) radiography, ultrasonic examination of fetus, amniocentesis.

There are already definite indications of the directions this medical specialty will be taking in the future.

1. Fetoscopy: Instrumentation for direct visualization of the fetus is now being developed. This technique is expected to allow the doctor not only to take external malformation checks but also to allow the extraction of fetal blood samples and placental blood samples, which could give clues to other, not-yet- developed abnormalities such as hemophilia or muscular dystrophy. It would involve the intrauterine insertion of a small probe housed within a tiny hollow tube.
2. Increased availability of testing programs to identify carriers of genetic disorders. Already developmental programs are underway regarding such diseases as Tay Sachs disease, sickle cell anemia, thalassemia, and lipoproteinemias (conditions inherited that

result in elevated cholesterol levels). Until a prenatal test is also available, there is much controversy over the usefulness of identifying and informing carriers, except in those cases in which carriers themselves might suffer harmful effects from the condition.

3. Improvement of karyotyping techniques to the point that they can locate abnormalities within chromosomes. This is developing as the result of new stains that actually cause the bands in the chromosome to become visible, resulting in the checking of patterns within chromosomes, not just large structural abnormalities.

Many genetically defective fetuses are not developing normally and are naturally lost through early spontaneous abortions (about 15% of all pregnancies end in natural terminations). 40% of all natural abortions occur in the first 90 days of a pregnancy. In families where early loss of fetus is common, one parent or the other is often found to have a previously-undetected translocation or other chromosomal abnormality.

When one of the methods currently available leads to the detection of a hereditary abnormality in an existing fetus, then the decision must be made regarding the continuation of such a pregnancy. Today, this is a very controversial, emotional, and legally-debatable area. Financial conditons also enter into considerations. For example, if amniocentesis becomes available to all pregnant women of age 40 or over (the most common age for mothers of Down's syndrome babies), about 18% of all Downs conceptions would be identified. Selective abortion of these fetuses (if practiced) would balance a yearly cost of $500,000 for the amniocentesis against a cost of care for the Downs babies that would run $3.1 million over their lifetimes,

effecting a savings to families and government of $2.6 million per year, at current rates of conception. (Figures from 1970 Ontario Canada study on Downs births in 134,724 births studies.)

What factors will dominate in the future, our skills in developing methods of sustaining the lives of genetically defective individuals or our skills in detecting and decreasing births of defective individuals? Will some balance be reached between these two points of view? Which is more valid, "right to life" or "genetic pollution?" These are hard questions and ones that will have to be resolved eventually on world-wide bases. Are there other possibilities? Genetic surgery?

FUTURE OF MAN Name_____

In the following match the statements to their most appropriate idea. Ideas are listed in the key. KEY:
A. cloning
B. amniocentesis
C. sex determination
D. abnormalities and abortion
E. transplants

___ 1. Taking of an organ or a tissue from one individual and placing it in another.
___ 2. The removal of an embryo before full term pregancy.
___ 3. Removal of a nucleus from a body cell and inplanting it in an egg cell.
___ 4. Using karyotypes to determine number of X an Y chromosomes.
___ 5. Process which allows sex and abnormalities to be known before birth.
___ 6. Identical copies of "parent" organisms.
___ 7. Process is successful because all cells have the full genetic potential.
___ 8. Based on the fact that cells are sloughed off as the growth process continues.
___ 9. Process holds very severe and real moral and ethical issues for those religious groups believing in the sanctity of life.
___ 10. Legal death would be a factor in this process.

In the following section you will base your responses on the karyotype that you have been given. Check [√] the statements in the blanks that apply.

___ A. normal male
___ B. normal female
___ C. sex abnormality
___ D. chromosome deletion
___ E. chromosome translocation
___ F. chromosomal trisomy

In the following section match the most severe technical or ethical problem relating to the use of the process. Answers may be used more than once.

___ 1. cloning
___ 2. Amniocentesis
___ 3. transplants
___ 4. abortion
___ 5. life-prolonging machines

___ A. value of all human life
___ B. human egg is too small
___ C. rejection
___ D. ability to know what child is prior to birth.
___ E. cost of providing them to all who

On the back or below, answer the following question worth 4 points:

1. Explain briefly what the Rh factor is and why Rh+ and Rh- are important hereditary considerations.

C/1970102

BIOLOGY AND THE FUTURE OF MAN: Transplants

A transplant in the context of this discussion is a section of tissue or a complete organ removed from its original natural site and transferred to the new position, usually in a different individual of the same species.

Historically, transplants in animals have been around since about 600 BC. Hindu surgeons of that time reconstructed noses from skin flaps taken from the arm. This method was introduced to Western medicine by the great Italian surgeon Tagliacozzo in the 16th century. The flap was left attached to the arm for two to three weeks until new blood vessels had formed, then the arm was cut free of the nose.

From the earliest attempts, the idea of the transplant has been to correct some harmful or absent physical problem in the individual. Skin, blood transplants can save lives in cases of severe burns or blood loss. Organ transplants can supply a missing function and save life in cases of fatal disease of vital organs, such as the kidney.

A skin graft (transplant) from one part of the body to another on the same individual is called an autograft. These cannot be rejected. (Note: transplants imply living, healthy functioning in the location to which they are moved) Transplants between identical twins - isografts - are not usually rejected either. Transplants between members of one species (homografts) and between members of different species (heterografts) are usually destroyed by the host body in a very short time (rejected).

Tissue transplants

1. Skin: Most skin transplanting is in the form of autografts at present, however there could be no doubt that if rejection of homografts or production of cloned autografts could be worked out, there would open up a whole new field of repair surgery. Currently skin transplants are

in three groups: flap grafts-in which skin remains attached to "old site" until attachment begins at "new site;" full-thickness free-skin grafts - in which skin of maximum thickness that can survive without blood supply is used in small areas; split skin grafts - in which actual thickness of skin is reduced to allow for quicker supply of blood to new cells. These grafts do very well over large areas, whether actually dervied from splitting the skin or cloning individual's cells, but at present both leave a shiny red appearance on the skin that is not approved of in some cases for cosmetic reasons.

2. Cornea: There are certain forms of blindness in which the eye is entriely normal except for opacity (cloudiness) of the front window, cornea. The opacity could result from disease or injury, but, if the damaged cornea is removed and replaced by a normal transplant, vision is restored. Since cells of the cornea remain vialbe (living) for some 12 hours after death, a cornea can be grafted if it is removed within that period. Cornea transplants are not often rejected because there is no blood supply to the organ and most rejection factors are carried in the blood.

3. Blood vessel: Most successful transplants of this type are autografts. One of the commonest and most serious blood diseases in the legs is the blockage of main arteries by fatty deposits as part of arteriosclerosis (hardening of the arteries. Sometimes this condition can be dealt with by removing a nonessential superficial vein from the individual, reversing it so that valves will not slow down the flow of blood and joining it to the clogged artery above and below the block, thus there is a bypass for the obstruction.

4. Heart valves: Valves allow blood to flow into and out of the heart and from one chamber of the heart to another. When they become diseased, blood supply to the body in impaired. Currently seriously damaged valves can be replaced by allograft, mechanical means or in some cases by the valve from another type of animal that has been "desensitized" (all characteristics of the former species neutralized (sort of like tanning leather). Many of these devices must be replaced after a few years use or they stop functioning.

5. Nerves: Nerves outside the brain and spinal cord have recently been found to regenerate if damaged, under certain circumstances. However, ther ehave been NO successful efforts to reconstruct damaged pathways because the surgeon has no means of knowing whether tissue removed is motor or sensory and whether the pathway into which the material is transplanted is motor or sensory. What usually results is "short-circuiting" of the nerve system in that area and it is currently agreed that mechanical artificial limbs often function better.

6. Kidney: The kidney was the first internal organ successfully transplanted in man. Effective control of rejection of this organ has been a reality for 10 years, but it is still too early to predict how long kidneys will function in new bodies. The patient may receive a kidney from a live donor or a dead person (cadaver). Such cadaver organs may not function immediately after transplantation and further treatment on an artificial kidney may be needed for a while. The patient is given drugs to suppress his body's natural systems of defense which would destroy the kidney as foreign tissue. Usually for a short while after transplant, the patient is kept in an isolation room with all materials handled and air supply cleansed to lessen the

chances of his contracting a complicating disease at a time when the body's defense systems would be incapable of fighting if off, due to suppression by drugs.

7. Liver and Lung: These organs are in the initial stages of transplant development. Success rate (survival or recipient) is very low at present. The longest survival of liver transplant patient is 4 years since the operation, but out of 102 known transplants only 8 persons have survived 1 year and only 2 have made it 2 years. The longest survival by a lung transplant patient is 10 months.

8. Heart: One of the simplest transplants (along with the kidney which involves few connections) is the heart transplant. Since 1968 there have been attempts with varying degrees of success to use cadaver hearts in cases of fatal heart disease. Currently the survival rate of patients treated at Stanford University Hospital is about 50% or 1 year. Estimated length of time before hearts are being destroyed by rejection is 5 years.

BIOLOGY AND THE FUTURE OF MAN: Life-Prolonging Machines

A person is severely shocked, has a heart attack or stroke, or is in an auto accident. It is necessary that the minimum life-support activities ... supplying oxygen to cells and basic nutritional needs, purifying blood of collected wastes.. be carried on at least until it can be dtermined if the life of the individual can be permanently safeguarded. A person who has a kidney disease or damage sufficient to cause the nonfunctioning of both kidneys needs life-supnort until medical diagnosis can determine the possibilities for recovery (restoring function to kidneys, transplant, etc.).

Machinery is currently availalbe that can serve as a temporary (sometimes long-term, but not permanent) aid in these circumstances. At present, use of respirators especially is receiving wide attention in terms of when and for how long this type of support should be maintained. Legal, ethical and medical issues are involved. It looks as if in the future the capacities for mechanical life-extension will steadily increase.. the limiting factors will be more nearly what we DECIDE to allow rather than what the technical capabilities are.

Current available equipment includes:

1. Heart-lung machine (various forms and sophistications) It is almost impossible to repair damage to the heart while it is pumping. Originally this type of equipment was developed to continue supply of necessary materials to tissues while the heart of an individual was stopped for repair. Such a system includes basically a pump for continued circulation of blood through the body and an oxygenator which adds oxygen, thereby taking over the prime function of the lungs. Usually the equipment was attached

to the patient by "cut downs" in perhaps an arm and leg, one attaching the machine to an artery and one to a vein.

Oxygen insufficiency and death of cells in the brain can now be stopped (at least temporarily) by machinery similar to the original heart-lung equipment. Currently "respirator" equipment has reached such a state of development that individuals whose heart has stopped or whose brain may be incapable of originating the signals necessary to stimulate heart beat can be supplied with oxygen and circulating blood.

2. Artificial Kidneys: These machines have now been in use for about 25 years in cases in which patients suffered severe renal (kidney) malfunction. Sometimes the use is simply to tide the patient over for a few weeks so that damage to his own kidneys can heal. The basic principle of the kidney dialysis artifiical kidney) machine is the passage of blood through very small channels between thin cellophane membranes. On the other sides of the membranes is dialyzing fluid into which unwanted wastes would pass by diffusion, cleaning the blood, which would be pumped back into the body from which it was removed. In 1969, the cost of maintaining a person on a kidney machine averaged $10,000 to $14,000 per year. Some physicians go as far as to call "social euthanasia" the current fact that perhaps 100,000 to 150,000 persons could, over a period of several years, probably be saved from dying by availability of more kidney dialysis equipment, cost of equipment, several billion.

This brings us to some currently wrenching decisions.. who gets treated ... does where one lives affect availability of these machines?... for how

long should equipment be used? .. Under what conditions should use be terminated?... Does a person have a right to pre-determine whether such machinery would be used on him in an emergency or for how long.. on and on..

In the future computers and their development seem to be linked to our capacities to sustain life by use of machinery. Also, one of the many "spin-offs" from the space program already completed will become more common.

It is also predicted that there will be a kidney dialysis machine .. a "take-home" model that will bring the cost of this treatment down to $500 to $1000 per year.

Intensive care units and emergency facilities of many types will be increasingly equipped with systems attached to patients by a set of sensors that detect even minute changes in heart rate, oxygen supply, blood chemistry. This data will be fed into a computer and will either trigger automatic turn-on of necessary life-support equipment or alarms that will bring personnel to the aid of the patient. Such sensors were used on space flights to detect and transmit to earth the vital signs of the astronauts.

Further refinements in the filtering and chemical balancing of equipment will extend the time that a patient can be maintained on respirators. However, there does not appear in the sources consulted for this report any estimate as to how long it will take for machinery to reach the point that damage to tissues and blood-producing capacities of the body can be eliminated. Currently, and in the foreseeable future, there would continue to be a limit, however, extended, to the time that life could be supported if the body did not have the capacity to eventually re-start its own life-maintenance systems.

The problems .. and promise are there.

C/1970102

BIOLOGY AND THE FUTURE OF MAN: Cybernetics

For many years there have been available to individuals who have lost or severely damaged limbs artificial substitutes that give varying amounts of assistance. As far back as the 13th century there is evidence that man used wooden legs and other devices to replace or assist in movement. Today we are beginning to see the development of very complex orthotic-prosthetic (O/P) systems. The orthosis part involves the aid to a weakened limb while prosthesis involves the replacement of a missing part of the body with an artificial device capable of performing, at least in part, the function of the missing part. The number of people that could be helped by these developments is very great. The conquest of infectious diseases has increased life expectancy already to the point where disability due to failure to systems is common in old age. In addition, the ever-increasing rate of injuries from vehicle accidents adds to the numbers of paralyzed and maimed and at present the Vietnam conflict has added many more. In 1969, we were averaging 25,000 to 30,000 amputations of arms or legs per year in the U.S., 12,000,000 people suffered from arthritis or rheumatic disorders affecting use of limbs, and 2,000,000 had strokes, and there were 500,000 or more quadriplegics. It is estimated that 2½ million people could be aided by O/P systems if the very difficult problems of patient acceptance could be overcome.

The human being and his assisting device comprise a man-machine O/P system... or a cybernetic system, using the word coined by Dr. N. Weiner in 1948. Usually such a system would, in the future be powered by an external source and would be under the control of the muscle/nervous activity of the individual.

This area of research is developing rapidly. Work falls into several areas:

1. Signal sources: muscle motion, eye transmissions, hearing, serving as a method of triggering the action of the prosthesis. There is a human desire to control and initiate the action of such a device. Research is even extending into areas such a voice controlled typewriters and direct talking input into computers that will perform functions for individuals completely without motor ability.
2. Transducers: "on-off" switches used to stimulate or stop some function. One transducer widely used today is the pacemaker for hearts that do not maintain normal rhythm. The equipment emits an electrical signal at regular intervals that stimulates the contraction of the heart muscle. In the future such devices might be microminiaturized and implanted in muscles unable to contract because of lack of nervous impulse. The first transducers of this type were implanted in humans in 1966, one of the major problems now being tissue damage and rejection over long periods of time.
3. Output systems: communicators that operate in response to some unusual signal or on verbal rather than physical signal (such as the verbally-activated typewriter already mentioned); environmental tools designed to work with O/P systems have been a direct offshoot of the limited motion possible in confines of the astronaut's suit. Vehicles controlled by voice or other O/P signals are also in developmental stages.
4. Prothesis: It is noted that the production of extremely effective limb prostheses is thought to be still several years away.

Problems with replacement and development of function in a synthetic limb are psychological as well as physical. For example, an individual with one below-the-elbow amputation might retain enough function in one arm to give him too little incentive to learn to effectively use a functional artificial arm. It is difficult also to match muscle connections of one remaining leg to the walking activity of a functioning artificial leg.

A great deal of effort, however, is currently being directed toward functional cybernetic systems for double amputees and those whose limb loss is complete. The most successful systems presently are gas- or electric-powered, but the look of the future of course would be nuclear power. Each clinical application is a major engineering accomplishment and an individual one. There are few facilities now outside of research hospital that can install a cybernetic system. Surgical techniques that enable the union of existing muscles and sensory equipment to wire and battery are limited.

In the future, the look is toward more and more complete "cybernetic labs" specifically set up to construct and install cyernetic systems. Microminiaturization of circuits and nuclear power will provide necessary size and power control. In the more distant future we are looking toward installtion of functional eyes (one of the major problems with sensory prosthesis is the current inability to connect wire to nerve), ear, and touch circuits.

Again we reach a point of determination.. what is reasonable?.. what is more technology than is ethical?.. who get treat?.. who decides?.. who pay? But perhaps ther eis less controversy in this aspect of biomedical research.

BIOLOGY AND THE FUTURE OF MAN: Cryogenics

Cryogenics involves the use of extremely low temperatures in effecting some type of physical event. Currently cryogenics involves the storage of blood and kidneys and corneas to be used by recipients after transportation. Cryosurgery is the destruction of tissue by means of extremely low temperatures. Temperatures as low as -200°F (-130°C) can currently be used without general anesthesia of a patient and with the use of hollow probes specially designed for the purpose, to destroy brain cells (frequently tumors) that would be unreachable by ordinary surgical techniques. Pain relief and reduction of size of cancers can also be achieved in some cases.

It is also possible to store sperms (semen) collected from cattle or other lines of animals in which breeding stock maintenance is desired and lower the temperature to -196°C for storage and even shipment to far locations in the world. Calves have been born from semen stored as long as 10 years. Theoretically it should be possible to produce more than 100,000 calves per bull annually by such a technique of storage and transport. In the U.S. 50% of all cattle now born are produced by artificial insemination from stored semen. In some countries 95% already are produced this way. In the future with space for maintenace of breeding stock becoming an increasing problem, it is predicted by some that domestic animals may one day be derived worldwide from only a few "genetically superior" males whose sperm is stored cryogenically.

Cryogenics seems to be another biomedical idea whose time is arriving. The idea is also being used on a limited scale currently to store human bodies by lowering temperatures into the ranges indicated and maintaining them indefinitely in tanks. The object of such storage is that one day when the disease that caused the death of the individual is successfully

conquered, the body will be "thawed out," repaired, and an attempt made to restore the life of the individual. So far only the sotrage has been accomplished in terms of whole human bodies. No understanding exists as to what would be necessary to restore life functions and no one currently knows how to "thaw" the body without cellular damage.

Lowering the temperature of the human body to a much lesser degree is regularly part of extended surgical procedures at this time and it is even credited with prolonging the life of individuals requiring such procedures as total blood exchanges by allowing a decrease in the metabolic requirements of the body temporarily.

Cryogenic applications to medicine appear to have a growing place in the world of the future.

BIOLOGY AND THE FUTURE OF MAN: Prenatal Surgery

To open the abdominal wall, uterine wall and membrances surrounding the developing fetus and extract the fetus, still attached to the umbilicus, leaving the placenta functioning is still in the future as far as human surgery is concerned.... but not too far in the future. Currently monkeys are operated on during the later stages of the fetal development and successfully returned to the uterus for completion of gestation. Major problems involve maintenance of contact between palcenta and uterine wall and maintenance of oxygen supply to fetus. Types of surgery currently being done on monkey fetuses include heart valve repairs and other types of repair that would drastically reduce the chances of the fetus reaching term development or being born and living through the first critical hours or postnatal life until surgery by normal techniques is possible.

BIOLOGY AND THF FUTURE OF MAN: Sperm and egg banks

As mentioned in 1-7, cryogenics can be employed currently for storage of sperms. Many human babies are already conceived using either stored sperm from a husband or donor sperm if the husband is infertile. In the near future there will also become available technology sufficient to allow the storage of eggs in a similar manner. Although all the technical problems involved in the implantation and maintenance of a pregnancy in such circumstances have not been solved, it is possible in the near future that our world will have to decide about the feasibility or ethical acceptance of totally artificially selected offspring.

BIOLOGY AND THE FUTURE OF MAN: Radiation

In 1895 Konrad Roentgen discovered a new kind of ray -- one which would expose photographic film but could not be detected by the human eye. These X-rays, as he named them, could penetrate human tissue and reveal the internal structure of the body. The people of the world were thrilled by the potentials of this discovery, but the thrill was soon tempered by concern as many of those who worked extensively with X-rays developed skin lesions and cancers on areas which had been exposed. It was not until 1927 that it was realized that an even greater potential danger existed as the X-rays caused permanent, heritable changes in the material within the cells of the body, changes that could, if the right tissues were affected be passed on to offspring. Soon it was found that other types of radiation (the sending out of energy from atoms and molecules as they undergo structural changes) were mutagens, substances capable of changing the inheritance of an individual.

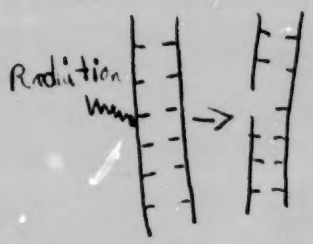
Many practical uses for high-energy radiation have been developed since 1927. Modern X-ray techniques permit the early diagnosis and treatment of many of man's serious illnesses. Radioactive isotopes injected into the body can reveal the sites of early cancer or other bnormalities. Industry is continually expanding its uses of radiation--it is used in everything today from testing ping pong balls for solid structure to powering nuclear submarines. Nuclear surface vessels, nuclear generating stations for electric power, and of course nuclear weapons are with us today.

Tomorrow will probably bring nuclear powered space vehicles, increased nuclear generation of electric power, nuclear powered cybernetic devices, perhaps even small nuclear generators for individual industrial concerns.

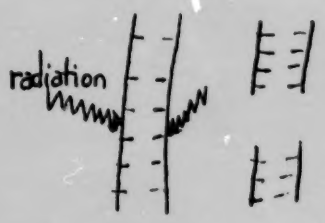
Also there is constant testing of nuclear weapons, even though most of this is now confined to below-ground areas.

Controversey exists over the amount of genetic damage which will result from the ever increasing earth-produced radiation increases. Also there is the problem of atmospheric changes (see oxone, greenhouse effect) that will change the overall exposure of the earth to radiation from space. What will be the long-range effect of this radiation on man's gene pool -- and on the genetic composition of the organisms man needs for food?

In general, the effect of radiation on the DNA of the cell (which will cause altered cells produced by mitosis or altered sperms or eggs produced by



Single Strand Break



Double Break

meiosis is to break the DNA, changing its code. The code, you will remember, is the instruction by which the cell operates to build protein.

What can be done about the dangers of radiation exposure? No one would suggest that we abandon the many increasing benefits resulting from our uses of radiation for peacetime purposes but in the future we must think of ways to minimize exposure at least above the background level that cannot be helped. If a few people were to be exposed to a heavy radiation because of a leak in an underground bomb test, many would be concerned. On the other hand, programs which scatter radioactive product over a side area and expose millions of people to a low level of radiation might cause little attention

but could do great damage for future generations by altering the available gene pool. Some biologists have estimated that as many as 6,000 harmful mutations might be introduced into the world gene pool as a result of the fallout from atmospheric testing of one atomic bomb.

We all receive a certain amount of background radiation. This comes from cosmic rays and from radioactive elements in the earth. In 1973, this amount was bout 3.5 units of radiation (rads) during a 30 year period. This amount has been noted to increase slightly due to changes in the atmosphere. We can also add to this 0.1 to 1.1 rads from man-made sources.

** SCENARIO **

It is another school day in Chad's life. As usual, when the alarm goes off, he adjusts the batteries which keep his heart going at the daytime beat; gets out of bed and takes an injection of the hormones that his body can no longer produce; adjusts the braces on his legs so that he can walk; dresses; goes down to breakfast which omits certain items that he cannot process; and gets ready to leave for the tube-transport ride to class. It is 2173 and Chad will study ancient times in which most of the people could actually live without artificial aids made necessary by the accumulation of mutations that now plague him.

****

What could be odne to decrease the rate of increase of exposure to radiation:

1. Cut the use, the strength, and the frequency of X-rays in non-essential medical procedures (this has been recommended by the American Medical Association in 1973).
2. Provide radiation-protection equipment for industrial workers.

3. Produce new, more effective methods of disposal of radioactive waste--no ocean dumping, or burying or dumping into fresh water.
4. Protect the public against such blunders as allowing radioactive contaminated wastes to be used in building materials for homes.
5. Reach international agreements regarding testing of atomic weapons. Agree to stop practices resulting in atmospheric decay.
6. Some suggest the establishment of sperm banks for those men whose jobs would require exposure to radiation, so that future children could be fathered from an unexposed reserve. Astronauts are one group for whom this idea may be reality.

Again we face the same questions--who makes decision concerning radiation exposure -- industry -- government -- do we need more laws? Few laws? -- What should be the penalties for disregard for public safety -- Can we stop environmental damage? -- Who selects candidates for sperm storage --There are benefits and hazards to weight -- and decisions cannot be long in coming.

BIOLOGY AND THE FUTURE OF MAN: Psychobehavior, mind-altering Drugs, ESB

As we move into the future, there seems to be a trend toward greater and greater control of various aspects of life. This appears to be coming because of the growing problems of population, pollution, hunger, etc. Another area in which advances are being and will continue to be made is the area of behavior control. This reading will concentrate on a few of the directions predicted for control of more negative forms of behavior, although one must not forget, that there could be room for turning these techniques in a less accepted direction.

Psychedelic drugs are those which, by definition have a profound effect upon the nature of conscious experience. As we move into the future, some predict growing and positive role for some of these substances in relation to treatment of conditions such as uncontrollable pain, terminal illness and alcoholism. LSD-25 is one of the psychedelic drugs with the greatest potential for positive performance.

These drugs can be used in the treatment of alcoholism (as studied since 1952 by psychiatrists such as Hoffer and Osmond) by allowing simulation of the conditions connected with the worst states of the disease (dilerium tremins-DT's) without having to wait for the accompanying bad physical state. Use of LSD-25 among alcoholic has shown that reconstructive help can be given much earlier and chances for recovery improve.

Mind alteration is also being studied for its applications in cases where death is inevitable and it is desirable to allow a patient and his family to view the situation realistically and to adjust thinking for planning and full use of remaining time of life. LSD-25 has shown in experimental, controlled situations, that it can, by altering the

consciousness temporarily, let an individual face fearful situations and discuss them with family and doctor.

Psychedelic drugs also seem to enhance the effect of potent pain relieveing drugs in the individual who is suffering intolerable pain. There is a continuing body of experimental evidence being collected on the favorable aspects of mind-alteration (temporary) by use of drugs. Note that in the majority of situations tested so far, the condition of the individual was extremely serious and in most cases, any bad effects (which do occur) from the use of the drugs would be secondary because the life expectancy of the individual is very short.

Another current and future application of mind alteration seems to be through the growing use of ESB, electrical stimulation of the brain. By using microelectrodes, it is possible to insert small wires into brain tissue and stimulate the neural (brain) tissue, at the same time recording the activity produced. neurons (brain cells) work in response to electrical signals. For example, it is possible to evoke fear-like responses by stimulating certain areas of brain tissue. Soon after it was noted that stimulation was possible, it was discovered that body movements and memories could also be produced by stimulation of various areas of brain. Electrical stimulation probably does not exactly duplicate the normal firing pattern of brain tissue, but methods of control are being produced that come close to allowing normal function in damaged areas or increased function of tissue.

ESB is currently performed only when a patient is operated on for some reason, to remove scar tissue, brain tumors, blood clots. Stimulation is sometimes a help in the surgery itself.

An interesting set of experiments was carried out by Dr. Wilder Penfield, Director or Neurological Research, Montreal, Canada, while he

operated on patients with temporal lobe epilepsy. Patients were fully awake and by use of local anesthetics, electrodes were implanted. Direct stimulation of cortical tissue is not painful because the cortex of the brain has no pain receptors. Areas of the brain directly responsible for seizures could be identified and cells in that area destroyed, thereby controlling the seizures themselves.

One of Penfield's most interesting discoveries was that when certain parts of the temporal lobe were stimulated "flashbacks" of previous life events could be seen. Since patient is fully conscious, events "seen" can e reported and later used in treatment of emotional or mental illness.

Also, through ESB research, we are gaining an increased understanding of the functioning of brain tissue and the uses of the various areas of the brain. Applications in the future for ESB seem to be great. This is a very controversial area of work, as is the work with mind-altering drugs, one reason being that people fear side effects and misuse of the techniques, invasion of family and personal privacy, and are concerned over regulation of experiments on humans.

In the future, however, these treatments may well have a place in producing better circumstances in which to live... and to die.

BIOLOGY AND THE FUTURE OF MAN: Euthanasia

This is literally mercy killing - the painless putting to death of a incurably ill or heavily suffering patient. This is the same thing applied to humans as is done to animals that are in great pain. It is interesting that humans are allowed to suffer and animals are given the relief of death. does this have some basis in ethical considerations, or is it just something that somebody has thought up?

The paper will look at both sides of the issue which is being and has been heavily debated over the world. First the affirmative.

In the affirmative statement it should be clear that there are two kinds of euthanasia. One is of commission and the other is of commission. Commission is sometimes called negative euthanasia and a positive euthanasia title could be given to omission. It the first there is a direct and concerted effort to bring about the end of life-giving of a poison, overdoses of medicine, etc. The other is to fail to perform surgery, hook-up life prolonging machines, etc. The differences are obvious. The first is training the moral bounds of doctors but since the doctor is to do the best that he can for the patient then there must be times when it is necessary in the best interests of the patients to simply allow death with dignity. Recently the Quinlan case in New Jersey has brought this type of euthanasia to national attention. The courts have ruled rightly so that to maintain a life like the one which Ms. Quinlan was "living" was a perversion of the medical ethics, legal obligations, and moral responsibility for the living. The first legal case over euthanasia was in Sweden concerning Dr. Olle Salin's discontinuing the intravenous feeding of an 81 year-old patient who had a terminal cerebral hemorrhage and who could not have lived more than a few more days. The courts have found that it was NOT murder to

discontinue the feeding in this case. The poet Arthur Hugh Clough wrote in THE LATEST DECALOGUE "...thou shall not kill but need'st not strive/Officiously to keep alive."

Negative statements are available from many sources. it is totally abhorrant to sensitive beings, to allow lives to be taken at the slightest whim. In the case of euthanasia the killing has only been elevated to a position of sanctioned murder. It make no difference whether the patient will die tomorrow or tonight it is the responsibility of the medical staffs to do all that is in their power to maintain the life of the individual. The argument that there are two types of euthanasia is really an attempt to hide the truth... that some proponents cannot face the possibility of being responsible for placing a hypodermic of poison into someones veins but this same thought if I don't actually hold the needle if I just unplug the machine then it is somehow alright is nonsense. The legal implications are and have been proven over the years that if you are present or in anyway a party to a crime then it is the same as if you actually committed the crime. Euthanasia is the same type of thing if one is party to such an undertaking then a verdict of murder is what the individual deserves. It is allright to talk about compassionate "murder" but what of the heirs who would like their inheritance a little earlier that they might otherwise get it. Doctors are not all lily clean saints some are totally unscrupulous and will be only too willing to turn off a machine for the right amount of money. We cannot leave it up to individuals to decide life and death. This bespeaks of Nazi Germany kill all those who are unfit. Rid the world of the infirm, the old, the blond, etc.

BIOLOGY & THE FUTURE OF MAN: Inequalities in care

"Health for All by the Year 2000" was the slogan proposed by the new director of the World health Organization this year.

The realities of the situation are that this idea is not within the current realm of possibilities... not even within the United States. There are great differences currently, and they are predicted to persist for many years, in the quality, thoroughness and modernity of care within this country.

A doctor that serves the patients in hospital wards and in private-patient sections of hospitals might notice the difference. Does a general practitioner in North Carolina's small towns know the avilable cancer treatments at the Mayo clinic? Can the male doctor or psychiatrist share the perspective of a female patient? These problems are tough enough without even considering...

Can a patient in South America get necessary open-heart surgery? Can a farmer in India afford to have the sores on his legs treated?

Inequalities in the delivery of health services have always existed. The problem is not to determine what should be done about these ideas: the solution is to eliminate the inequalities. Practical considerations are overwhelming... cost ... personnel needed... time... political differences between countries... and the ever-growing problem of scientific personnel knowing about the newest developments.

In the future, there must be faster, more reliable methods of spreading scientific informtion... one futurist suggests a world-wide computer hookup which would give up-to-date research information on all topics upon demand. People need to be better informed in areas that will result in their requesting more information. In this country, at least, there might

eventually reach a point at which equality could be obtainable... but worldwide? What about all the "backward" societies ... where problems of unsanitary water and infection from parasites must be fought long before one needs to worry about heart transplants. The American Friends Service Committee has noted in a paper: "a single heart transplant costs $20,000 to $50,000. How many individuals could be rehabilitated with glasses, hearing aids, or dental care for the cost of one heart transplant?"

Dr. Rene Dubos, famous scientist at Rockefeller University in New York asks how can one talk of equality of health care:

> "Why become so excited about a few hundred organ transplants. When every day in New York, thirty thousand children are exposed to the possibility of permanent handicaps from lead poisoning and on one is doing anything about it."

There will only be so much money available to develop governmental programs. How much should go to, say pollution control or land use planning and how much to equalize medical services within this country? In other countries? Dr. Amitai Etzioni, genetic researcher, points out that in this country we spend $11,000,000,000 a year on cigarettes. At what level are we willing to pay for equalizing medical services?

**** SCENARIO ****

Time: present

Mr. A. is a resident of a rural Tennessee community. One evening as he steps out to the road in front of his home to get the mail from the mailbox, he is struck by a hit-and-run driver. Mr. A suffers massive head and chest injuries. He is taken to the town hospital (25 beds, 2 doctors), is treated to the best extent available, and dies of his injuries in a few hours.

Mr. X is a resident of Philadelphia. He is crossing the street on his way to work against the light and is truck by a car, receiving massive head and chest injuries. He is quickly placed in an emergency vehicle equipped

with respirator which takes over his breathing function. He arrives at one of the city's hospitals (498 beds, 500 doctors on staff) and is checked by a leading brain surgeon. Within one hour he is in surgery and within 6 hours he is out of danger of immediate death, although he has need to retain the use of the respirator for 2-3 weeks.

****

What similarities and differences are there in the above situation?

There could be many similar examples, within and without the U.S. Everyone agrees that in the future we need to eliminate inequalities in medical care. The questions that must be answered are... how do we finance? ... Who has responsibility in various world areas? ... what are the limits of experimentation and changes in individual rights allowed in the name of equalization?

BIOLOGY AND THE FUTURE OF MAN: Germ and Biological Warfare

Any type of warfare might be considered to be biological since it is always biological organisms that get killed. For the consideration of this paper the terms will be defined as chemical and biologic agents that kill or incapacitate. Much of the definitive information came from a SCIENTISTS' INSTITUTE FOR INFORMATION WORKBOOK the title: ENVIRONMENTAL EFFECTS OF WEAPONS TECHNOLOGY.

Looking first to the chemical aspect of wars in the future we are reminded of the Viet Nam war in which there was wide-spread usage of certain chemical agents. It is true that these agents were directed toward plants rather than humans but the usage is noteworthy.

The main purpose is not to consider side effects toward humans but to look at the main antipersonnel types. They fall into six rather arbitrary categories according to SIPI. They are listed in the table below with their actions.

Irritants - an example is tear gas.

Psychochemicals - most common d-lysergic acid diethylamide works without victim knowing it.

Vesicants - mustard gas; forms blisters; gas or liquid.

Lung irritants - phosgene and chlorine are examples

Anticholinesterases - breaks down the body's ability to transmit nervous impulses.

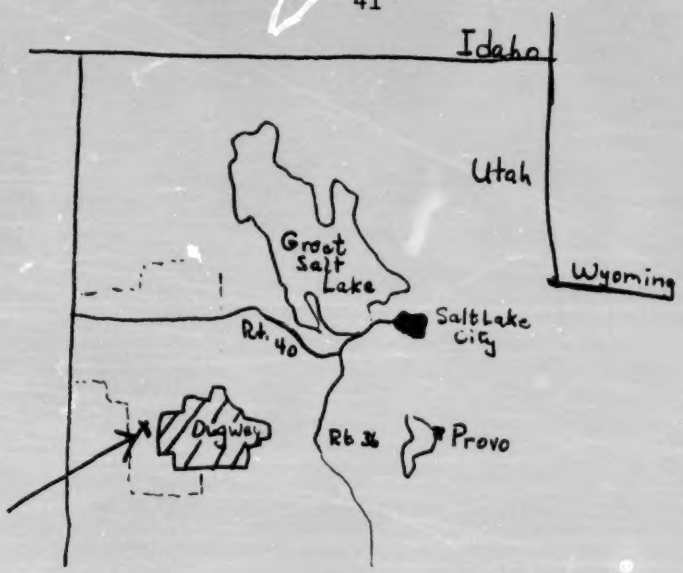
There are certain military advantages to the use of these chemical agents: cheap and easy to produce; easily tailored by a commander to produce just the right amount of "kill;" many delivery systems; are pervasive and reach without destroying installations.

From a sociopolitical aspect there must arise the issue of the right and responsibility to use these agents or another on unspecting non-military persons. Does the old adage that all is fair in love and WAR really hold true? if it does then there is no reason for us in the United States not to develop those agents that are the most effective. It is the opinion of some that it is to our advantage to have materials at least as deadly as those of any power that might try to oppose us in the military sense. Does this really make sense?

The obvious issue is whether the U.S. should resume its overt testing program which ended in the early 70's. The pressure to halt the tests was tremendous. Congress and the public as a whole seemed to think that the fact that the USSR was developing these same type weapons did not give us the right to do so. This group argued convincingly that the responsibility the U.S. had to the world outweighed the right to 100% protection. This is a very tenuous issue in the minds of many persons in the general public as well as to the military.

Not only does the question of chemicals arouse the passions of people the twin, that is biological agents, causes passions to run even higher. The first public outcry of the use of biologic agents occurred in after the Dugway incident in march, 1968. This celebrated kill of sheep outside the Army's proving ground in Utah was reported across the nation and the public and the reporters became enraged with the callous manner in which the lives of the American people were being endangered by the Army's experimental program. Map of the Dugway site is on the next page.

This incident and others which were reported in the media at the time leave little doubt that the U.S. is certainly capable of mounting a very effective attack from the standpoint of biological agents. As early as 1963



one Lt. Col. Gouchenour estimated that 250 liters of a highly concentrated agent could blanket an area roughly one-third the size of New York State and cause the populace to be exposed at a level 1,500 times more that the theoretical dose to cause infection.

American research has been confined to two known areas: one Ft. Detrick, Md. and the other Pine Bluffs, Ark. These areas have been working on four major strains of infectious agents anthrax (killer of the Dugway sheep), tularemia commonly known as rabbit fever, Q fever a sturdy infectious disease lingering for months, psittacosis or parrot fever. Whether these agents are ever used the danger that they present is real and the reproductive rate of viruses 12,000,000 per week is frightening.

Probably the most frightening of the aspects is that the possibility of escape of one of these virulent organisms is great. The scenario might read like the ANDROMEDA STRAIN. This book is excellent reading for those who haven't read it.

The last idea for this paper comes from the United Nations Report on Chemical and Biological Warfare (CBW). This was presented to the UN General Assembly in 1 July 1969. The paper concludes in part

> "...Were these weapons ever to be used on a large scale in war no one could predict what the effects, or how enduring they would be, and how they would effect the structure of society and the environment in which we live. ... the danger of proliferation belongs to all... ."

BIOLOGY AND THE FUTURE OF MAN: Machine Technology

One of the major outgrowths of our current technological age is the proliferation of machines that work for us. The work force itself has been influenced into optimal production based on machines. There has been both good and bad effects from this dependency on machines. it has allowed us to rely heavily on these machines in some cases so heavily that we have lost the ability to perform some of the functions that we know take for granted. The advent of cheap machines has allowed almost every school child to have a pocket calculator that adds, subtracts, multiplies, divides, etc. In other words, we no longer need to understand the manipulation of numbers only have the ability to plug them into a machine. This can call up a frightening scenario of machines in revolt if the reader has seen the popular movie "2001" then he will be aware of one of these possible futures.

Good effects of these developments are numerous it has enabled us to devot more time to the esthetic pursuits, enabled us to pursue the real problem without the encumberances of the tedious calculations, it has given us a great deal of leisure time. With these very wonderful things it might seem amazing that anyone could see any harm in the technological revolution which we have undergone.

The real criticism is not in the revolution itself but in the changes that it has made for the American people and the world-outlook that we hold. It now seems that we see nothing as impossible just turn it over to the computer. COMPUTER that name alone strikes a note of awe and wonder in the hearts of the people who hear it or read it. Why? We have been leaning toward the idea that there is no wrong in the computer. Computers do nothing they only do what people tell them to do. This is a true statement but the fact that the computers exist causes people to have a different

outlook on the world. It might be avowed that we see the world through the eyes of a computer. This would probably be a just criticism.

It is not the purpose of this paper to say that all technology is bad and that we should revert to those pre-technology days when the sheer drudgery of the work removed much of the pleasure of accomplishment. It is not designed to point out all the faults of the system that has spawned the United States as we know it. It is really designed for YOU the future voting public to ponder the issues and to make some kind of logical, reasonable decision as to the direction that we are to take in the future. Most of you have probably not thought much about all the machines that you use in your daily lives unless you are aware of the number then the focus of this paper will be lost on you. What you should do is to think of the machines that you used last night before you went to bed... a partial possible list follows add other things of your own:

refrigerator	stove
lighting	TV
radio	stero
calculator	typewriter
watch	door bell
bath room facilities	coffee pot

It is not in the machines that you used these are very common but think of all the input that was necessary for just the TV program:

BIOLOGY AND THE FUTURE OF MAN: Human Experimentation

Perhaps the single most horrifying occurence of the last 100 years was the Hitler regime in Germany. It was this leader who engineered the mass extermination of millions of people because of some preconceived idea of a "super race." This over-riding idea is of superiority of a "race" is prevalent again today. We talk in the medical circles of perfet children, life without deformity, life without death. The only way that these happenings are going to occur is to use the human body itself as the experimental laboratory.

If this idea sounds ghastly then I would recommend the reader to certain experiments carried out by the U.S. government in the name of science to determine the effects of syphillis on men who received no treatment. The same thing has been alleged about the swine influenza vaccination program but the guiena pigs here are on a national scope and in temendous potential numbers. Does our govenment not experiment on humans? The answer resoundly is YES IT DOES!!! Troops are experimented on to determine whether they can stand the rigors of capture. Living and breathing humans are used. This is a case that is destined to come before the Supreme Court of the United States.

If these types of experimental activity are not to your liking then perhaps the experiments conducted on newborn, deformed infants albeit dead. Sometimes with the consent of the parents sometimes not. Cadavers are used for teaching purposes and also used in some experiments where living beings cannot be like in crash tests of cars, planes, etc.

There are no doubt times when it is necessary to sacrifice some so that the majority might survive. But this very idea of using humans as experimental animals is somewhat distasteful. The end result is a good one

in that he lives of many people are saved through what is learned from the few who are sacrificed. Perhaps the edict that was mentioned in the Bible "no greater love hath any man than to lay down his life for a friend," would be applicable. If a person choses to participate willingly in an experimental program then should the government or the citizenery interfere? This is a question of great importance as we will need to go more and more to human experimental work to probe the miriad of problems that still afflict us.

Perhaps the experimental work can be conducted as in the current drug tests. The person has to show no improvement on a conventional drug before a potentially dangerous drug is tried. If this is the procedure then maybe the support would be stronger. With the public's right to know becoming increasingly important and the tendency of the public to <u>demand</u> to know then maybe we shall see a little more truth in these experimental undertakings.

BIOLOGY AND THE FUTURE OF MAN: Balanced Populations

When considering the population problem it is important to remember the four factors which influence populations. These are:

1. natality - this is the birth rate
2. mortality - this is the death rate
3. immigration - this is the rate at which persons enter an area
4. emigration - this is the rate at which persons leave an area

In addition to these definitions the reader needs to be aware of the following also:

1. density - this is the number of persons per a given area. (150 per square mile).
2. carrying capacity - this is the number of persons that a given area can support. (deserts have a lower carrying capacity than a jungle)
3. doubling rates - these are the rates at which the population takes to double itself. (world doubling rate is now around 35 years)

* SCENARIO *

"The troops were standing guard at the border, too many people had been sneaking across the border. The population in the United States had reached the ultimate limit as determined by the Population Review Board. If any one else was to enter the country then someone had to leave. This procedure had been law ever since the Lifeboat Ethic proposed by Garrett Hardin was finally taken seriously. What he said in the original document was that we in the US were going to have to look more closely after our own self-interests. If we wanted something, we would have to take it. Also since we were so prosperious then there must be a continuous guarding of our borders. This is like a ship that sank at sea and there was only one

lifeboat. Let's say that the lifeboat held a maximum capcity of 150 persons. These could survive for several weeks. With fewer persons then the remainder could survive longer waiting for rescue. Hardin in his ultimate wisdom forsaw the time when the population in the US would be like that overcrowded lifeboat. If you were in that lifeboat and it was full and someone came to get in and this threatened to tip the boat over what would you do?" The teacher had just finished reading the required passage and immediately the class chorused, "KILL THEM!! KILL THEM ALL!!!"

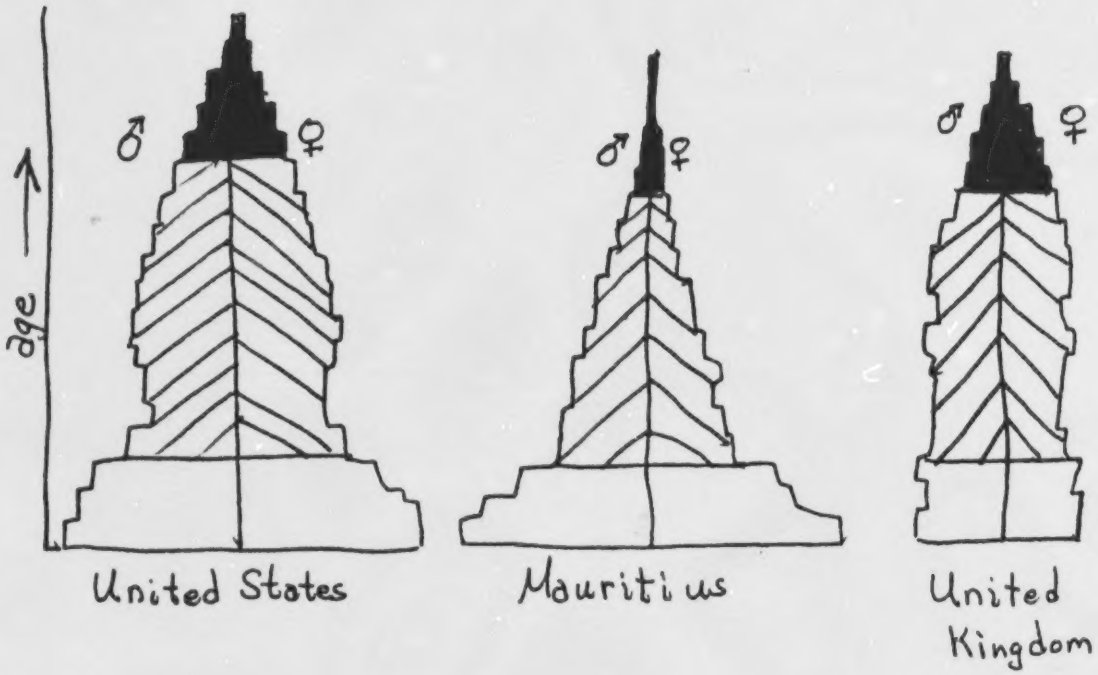
[end]

This scenario is not a pretty thought. But Hardin has written such a paper called Lifeboat Ethics and there are a number of people who feel that the man is right. It seems to be a return to the laws of the jungle. Our only hope as civilized people lies in total education about the population problems that Hardin sees as so potentially dangerous. The danger of which he speaks is real and it is the ultimate response to this danger that determines our humanity.

One possible step to help the education effort along was proposed by Paul Ehrlich. His theory is called TRIAGE (tri'age). This is the same theory that has been used on battlefields by surgeons for centuries. It simply necessitated that the injured be divided into three groups... 1) those whose injuries while perhaps painful were not too serious, 2) those whose injuries were so serious that there was no chance for them to survive and, 3) those who could be saved if help were immediate and massive. Groups 1 and 2 were ignored if there was a large casuality count and all efforts were devoted to group 3. Ehrlich proposes the same kind of procedure for countries who are having population problems. We should divide them into the three groups and then act to save those that can be saved. His basis

for this approach is that our resources are limited and therefore we could not help everybody even if we chose to do so.

The study of populations is called demogrpahy and it is through this study that we can see the problem as Ehrlick saw it. The three charts which follow are called AGE STRUCTURE charts and show the three different segments of any population. Those under 15 are called dependent or prereproductive. The group 16-65 are claled reproductive or productive and the group over 65 are called postreproductive. It is the group that is under 15 that causes the future growth of the population. Compare the three charts below.



In the future the trends to look for are more demands from the elderly as we see the effects of "death control" getting more old people. Expect to see populations really take off in the under developed countries (UDC) since there are alarming large numbers of people under 15. Expect more famine,

more disease, more demands on the U.S. and other industrialized countries to meet the needs of the UDC or the Third World Countries.

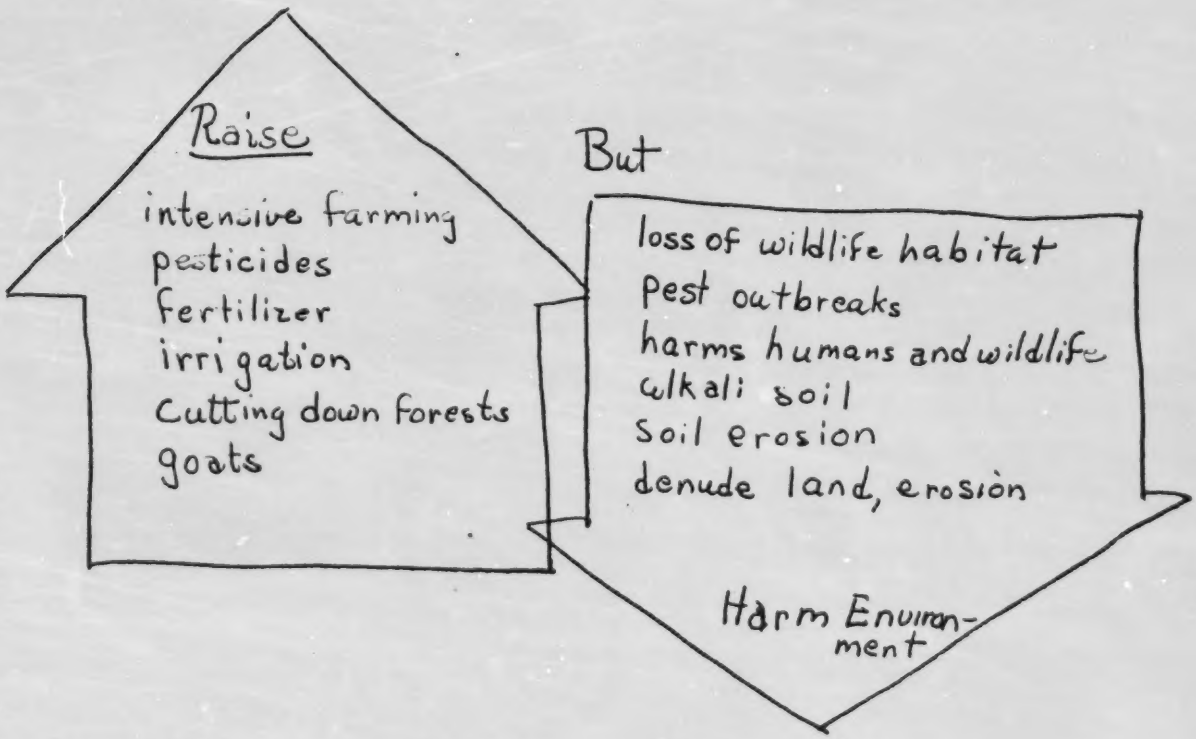
Populations may have to be governed according to the theories or Hardin-Lifeboat or of Ehrlich - Triage; the real solution is up to the people who make the decisions about this future. If this one aspect is chosen incorrectly then the other aspects won't matter.

BIOLOGY AND THE FUTURE OF MAN: Green Revolution

The term Green Revolution has been applied to the agricultural changes which have taken place over the last 25 years or so. Prior to this time there were substantial developments in the area of agriculture but it was not until the work of Norman Borlaug that the development was significant. Green Revolution is a term that is used to dramatize the increased food production.

There are three important components to the modern Green Revolution and they are increased usage of pesticides, inorganic fertilizers, and irrigation. All of the separate parts must be used to get the desired results.

Almost every thing that occurs has both negative and positive effects. These could be termed paradoxes. In the following figure taken from INTERNATIONAL WILDLIFE, July/August, 1972, you can see these paradoxes.



Further consideration of these paradoxes can be seen in the following break down. These tables consider six of the major segments of the problem and look at them from the content itemization, environmental implication, and outlook for future food production.

1. Interference with water cycle
   A. irrigation, dams lakes, chemical rainmaking, desalination
   B. dams trap nutrients, prevent natural deposition, most U.S. rivers maximally dammed, alters freshwater habitat. Costly for UDC's.
   C. cost implications for UDC's great and probably unaffordable.
2. Altering energy cycle
   A. harnessing animals to work in field; technology has reduced the number of people required
   B. side effects are minimal
   C. UDC's haven't money to sustain the mechanization.
3. Expanding teh area under cultivation
   A. clearing forests; using arid lands with irrigation
   B. cutting forests have soil erosion--loss of soil and nutrients; removal of O_2 from ecosystem; slash and burn leaves a soil that quickly wear out.
   C. U.S. has most of the aerable land. Most poor countries are in tropical or semitropical with inferior soils. Balance of payments makes it impossible for those who need the food to buy it.
4. Breeding and genetics
   A. First cows gave 272.7 kg/year; now give 3636.4 kg/year first hens gave 15 eggs/year now give 200 eggs/year. Rice produced

at rate of 797,391 kg/hectare and after breeding produced at the rate of 11,231,818 kg/hectare.

B. New breeds of animals require high protein food that is bought from poor countries who sell to the U.S. at a high profit rather than to their own countrymen at a lower margin. Chile and Peru do this all the time.

C. Hybridized grains depend on fertilizers and pest control. All the world soybean crop is from six hybridized strains with the same genes basically and therefore the same disease susceptibility.

5. Fertilizers

A. Continued use allows repeated use of field for same crop.

B. Excess use destroys humus demanding more fertilizer, etc. run-off triggers water eutrophication (aging); causes farmers to replant the same crop in same area causing the spread of diseases.

C. Fertilizers are expensive; poor farmers are generally undereducated and resistant to innovation; doubling the world's food supply would require the amount of fertilizer used to triple.

6. Pesticides

A. Pesticides have prevented crop loss to pests; have also encouraged one-crop plantings

B. Some pesticides interfer with wildlife reproduction; have been shown to reduce the amount of photosynthesis in plankton.

C. Pesticides are expensive; the pesticides are not pan-effective (i.e. not effective over all the world); pests can get immune to the pesticides and thus require more or different ones to be effective.

Dr. Norman Earnest Borlaug winner of the Nobel Peace Prize in 1970 says, "The Green Revolution offers the possibility of buying 20 to 30 years time in which to bring the population in balance with food production... the inexorable Malthusian forces will once again be operating--unless man uses the time to achieve broad scale population control."

A future scenario of people fighting for food in the streets is no longer science fiction but a fact of life in many UDC's right now. The U.S. might also have food wars if there is ever a famine causing drought, flood, or other unusual events in our breadbasket-the Midwest.

To eat or to reproduce this might be a choice for the future. It appears that both cannot occur at the same time.

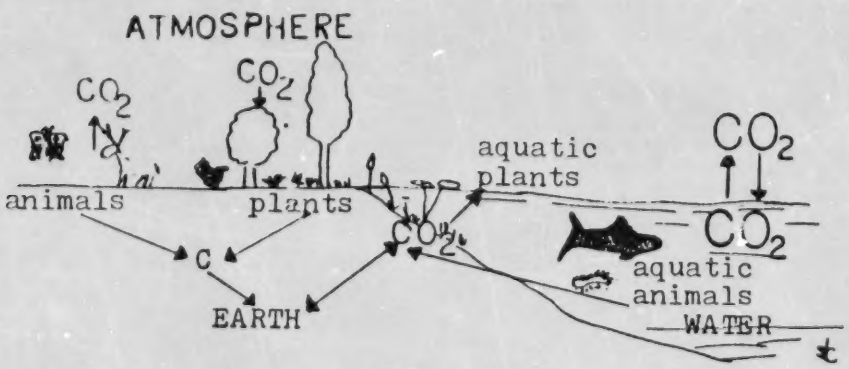
BIOLOGY AND THE FUTURE OF MAN: Greenhouse Effect

* SCENARIO *

Boom! Boom! Boom! The room rocked with the blasts that had been triggered to prevent the earth from overheating. What? Oh, yes to those of you who do not know... the regular blasting and the large amount of dust in the air prevents the heat from coming in. You see there is known to be a definite balance between the amount of dust and the amount of CO_2 (carbon dioxide) in the atmosphere. There is also a relationship as to the temperature. The more CO_2 then the greater the temperature (>) the more dust then the less the temperature (<). Never thought we'd see the day when those x@%&*X@# scientists would come up with something useful.

[end]

As early as 1899 an American geologists warned about the possible effects of too much CO_2 in the atmosphere. He said at the time that there could be a heat build-up. This heat build-up could raise the temperature of the Earth and then we would face the very real danger of flooding as the polar ice caps melted. Since 1899 the cycle of CO_2 has been mapped and it is now known why the predication has so far not come to pass. The reason can be seen in the diagram below. The things to note are the two sinks of CO_2. The atmosphere and the oceans. Both of these can provide the other with excess CO_2. The balance is termed a dynamic equilibrium.



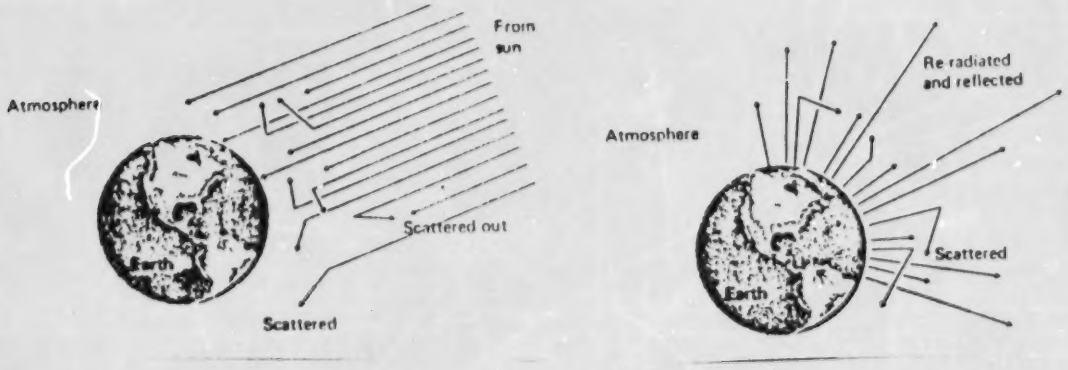
After the CO_2 gets into the atmosphere it will follow the following pattern. The material has been excerpted from Barry Commoner's book called the CLOSING CIRCLE:

"Over a long period of time, changes in the composition of the air can have strong effects on the amount and kind of solar radiation that reaches the earth's surface. These effects are brought about by changes in the amount of airborne dust particles, water vapor, clouds carbon dioxide, and ozone. Generally, water vapor and clouds have a shielding effect; solar radiation is scattered by water droplets, and much of it may fail to reach the earth. This is why cloudy conditions tend to reduce the temperature of the earth. Carbon dioxide has a special effect because it is transparent to most of the sun's radiation except that in the infrared part of the spectrum. In this respect CO_2 is like glass which transmits visual but reflects infrared--the properties which make glass so useful to a greenhouse in the winter. Visible energy enters through the glass, and is absored by the soil in the greenhouse and converted to heat, which is reradiated from the soil as infrared energy (heat energy). But when this energy reaches the greenhouse glass, it is bounced back and held within the greenhouse as heat. This is why an otherwise unheated greenhouse is so warm on a sunny winter day. Like glass, the carbon dioxide that blankets the earth acts as a giant energy valve. Visible solar energy passes through it; reaching the earth much of this energy is converted to heat, but the resultant infrared radiation is kept within the earth's air blanket by the heat reflecting property of carbon dioxide."

It should be pointed out that this is a theory and that it has NOT been proven beyond a shadow of doubt. Evidence tends to point to the same conclusion that Dr. Commoner reached; but the jury is still out.

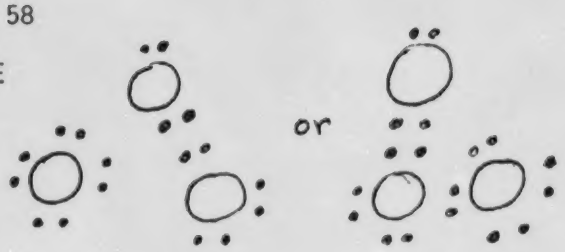
For whatever reason, we have been burning more and more of the fossil fuels and there has been an increase in the amount of carbon dioxide. If the sink hypothesis (storage in the water system) is correct we should soon begin to see large amounts of CO_2 being released into the atmosphere according to the diagram on the previous page.

Following is a figure taken from BIOLOGY: evolution and adaptation to the environment, by Kelly and McGarth, 1975. It shows that about half the infrared solar radiation never reaches the earth because it is reflected or absorbed in the atmosphere. The absorbed section is causing a warming of the atmosphere figure (a). The second figure shows that there is a reabsorption from those wave length reradiated from the earth and captured in the CO_2 (fig. b).



So for the future there are several futures... one of a continual playoff between the heat absorbing CO_2 and the heat rejecting dust just like in the scenario... another would be the status quo with no effects seen... another might see the tremendous heating and the melting of the ice caps. Only time and research can decide which will be the alterntive future which comes to pass!!!!!

BIOLOGY AND THE FUTURE OF MAN: OZONE



In considering the question of ozone and the role that this may have on our future it is first necessary to quickly review the basic chemical facts of this gas. Ozone is a compound similar to oxygen and is written chemically as O_3. It is a bluish gas with a pungent odor. The boiling point is -111.9°C and the freezing point is -192.5°C. The two diagrams at the top of this page represent the way that the three atoms of oxygen combine to form ozone. The electrons in the outer shells are shown by the dots. The diagram has two parts indicating that the chance of finding either one or the other is 50-50.

Ozone is formed naturally when oxygen (O_2) absorbs radiant energy at 190 nm (nannometers; 1 nm = 0.000000001 m) and lyses (splits) releasing free O this combines readily to form O_3. The atmospheric levels at which this occurs is generally around 22 km. This is about the level dividing the stratosphere and the troposphere. There is a migration of the layers of ozone generally they stay in the area of the stratosphere for 4 months and for 2-3 months in the troposphere. The level of natural production and destruction is staggering exceeding 1.8 quadrillion kilograms per year or in long hand 1,800,000,000,000 kg. [Newell, 1971].

While the ozone formed high in the stratosphere presents little danger to man on the surface it does provide him with a significant amount of protection. It prevents the ultraviolet waves of the spectrum from stricking the surface and causing cancerous effects. In addition to this

major feat there is the heating aspect that is accomplished. It has been guessed by R. L. Smith that if the ozone layer were absent then the temperature at the stratosphere - troposphere interface would be in the range of -57°C rather than the present -1°C. The concommitant decrease in surface temperature would be substantial.

If the layer of ozone were to fall toward the earth there would be little danger from this very dangerous oxidizing agent; by the time that it had traveled very far toward the surface it would be broken up by the many reducing compounds--aerosols of all types would cause a breakdown. Also even if it reached the surface it would compact to a layer 0.25 cm thick or about the thickness of a quarter!!

This is not to say that the damage would not be significant, at concentrations of 0.05 ppm (parts per million) it would become a significant irritant. At 0.1 ppm it would cause dry throats and respiratory problems. At 0.8 ppm there would be widespread deaths attributable to the ozone.

Not only would people feel the effects plants and other animals would also be affected. Today ozone damage in plants is noted particularly in tomatoes and tobacco; symptoms include discoloration, spotty areas on the leaves.

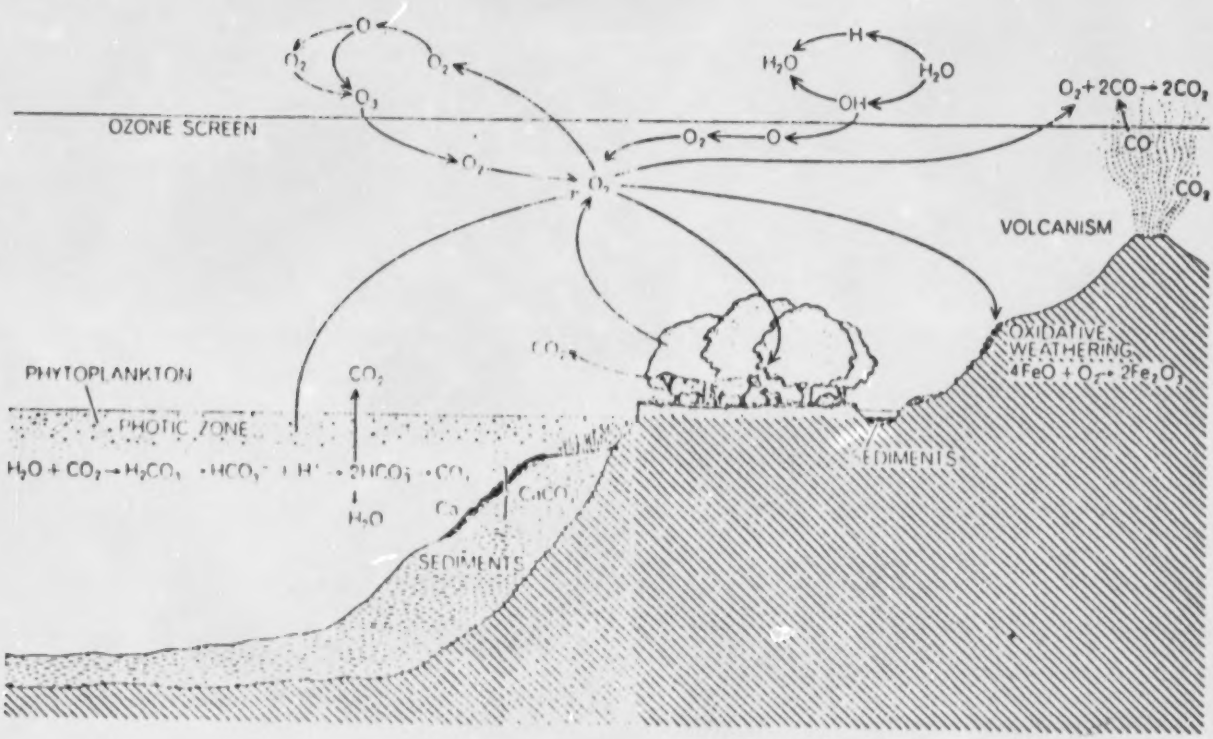
Ozone also shortens the life of rubber products and textile goods. Recently there was a case in New Jersey where a whole jr. varsity football squad was taken to the hospital after having practices when the ozone level was high. In California schools in the Los Angeles' Basin there are pollution watches for ozone and when the alerts goes out there is to be no strenuous activity.

The present furor over the ozone question falls into two categories: one dealing with the natural ozone and the other with the artificial (i.e. man-made) ozone. First to consider is the man-made variety.

Ozone is formed in a chemical process that accompanies burning. In any burning process there is generated a quantity of nitrogen oxide. This in the atmosphere is converted through the action of sunlight into nitric oxide and a free oxygen. Free oxygen combines almost immediately with O_2 giving rise to ozone O_3. In Los Angeles it is not uncommon to see levels of ozone 10x-20x greater than is considered healthful. The action of the sunlight in triggering the decomposition is called photochemical action. The particular type of smog is often called Los Angeles smog.

From this it is rather obvious that ozone is not wanted near the surface of the earth. But high up it performs a very valuable function--absorbing potentially harmful ultraviolet rays. What is harming the upper layer of ozone is not proven beyond a shadow of doubt. It is alleged that the nitrogen oxides generated by a plane called the SST (super-sonic transport) would deplete the layer according to the formula $NO + O_3 \rightarrow NO_2 + O_2$ and $NO_2 + O \rightarrow NO + O_2$. From this it can be seen that a potentially dangerous chain effect would be initiated destroying much ozone. If 5% were destroyed it is estimated that life as we know it would cease to exist. [Newell, 1971].

Following is a diagram taken from Scientific American, Cloud and Gibor, September, 1970, "The Oxygen Cycle." It attempts to show the interrelationships between O^2 and O^3. Study it carefully.


O
O2
O2
O3
O3
O2
H
H2O
H2O
OH
O2
O
O2+2CO→2CO2
CO
CO2
OZONE SCREEN
VOLCANISM
OXIDATIVE WEATHERING
4FeO + O2 → 2Fe2O3
PHYTOPLANKTON
CO2
PHOTIC ZONE
H2O + CO2 → H2CO3 + HCO3- + H+ + 2HCO3- + CO2
H2O
CaCO3
SEDIMENTS
SEDIMENTS

BIOLOGY AND THE FUTURE OF MAN: Noise, Sewage, Metals, Solid Waste

Many pollutions are talked about today. There is a mood that there is little hope of surviving them. The future does seem bleak when one considers the many things that are happening to the environment today that could lead to complete anihilation of life as we know it. If not total destruction then at the least the massive waves of change seem inevitable.

Noise is one pollution type that has received very little attention from most of the environmentalists until recently. This problem is a major one because it may be causing an assault at the primary human level--nervous system. It is known that excess noise can cause very serious digestive and circulatory problems. These problems occur whether there is a conscious knowledge of the noise or whether the noise patterns have become conditioned into the background level.

Sound and noise (unwanted sound) are measured in a unit called a decibel (dB). Quiet is a noise rating of 0 dB. The softest sound that can be detected is 1 dB. If a sound is 10x the softest sound the dB rating is 10. If 100 then the rating is 20 dB. In other words there is an increase according to the powers of ten. 1000 x would be 30 dB.

Noise at 50-55 dB interfers with sleep. Evidence now points to the 90 dB level as causing irreparable damage. Insurance claims last year for hearing loss exceeded $1,000,000,000 (one billion).

When describing noise people generally refer to noise that they can detect. This leaves out a large segment of sounds - those too high to be heard and those too low to be heard. These are termed ultrasound and infrasound, respectively. It is infrasound that may be the most damaging. it is the sound that is felt. This is the sound component that is considered to cause most deafness and most psychological or mental problems.

Sounds of all types have been increasing at the rate of 1 dB per year. It takes little figuring ability to determine that soon there is going to be an unbearable sound load. Shielding and proper precautions and mufflers for loud sounds offer the only hope of continued sanity and hearing.

In addition to the noise problem there is another that affects mostly people directly who live in urban settings. This is the sewage treatment. Treatment can take several forms. There is primary treatment which only allows the solids to settle out. Then there is secondary treatment which allows settling, but in addition uses the presence of some bacteria and algae to remove much of the pollutants. Tertiary treatment and quaternary is taking the water further... treating the water with various chemicals, filtering through membranes, and many other things.

The two major elements that are released are those two most often associated with humans..nitrates and phosphates. These are not poisons in the sense of the word that they are dangerous. Indeed they are not dangerous except in large quantities. Quantities of these however cause all water systems to go through a rapid algal growth called eutrophication. Even the best systems are unable to prevent the occasional release of these and other materials into the environment. There is the problem of having sanitary and storm sewers as one and the same. There is a problem in that some of the newer chemical processes are dumping into the system species that it is not equipped to handle. These plus the various monetary considerations in building adequate treatment and policing to make sure that no one is dumping into these the exotics or straight dumping into the rivers and streams is a task that requires more man-power than is presently available.

Some of these exotics do not appear just in the water supplies but is food, air, water, and a variety of other sources. The class of matrials referred to are the heavy metals-mercury, lead, beryllium, as well as asbestos.

The first well-known case of mercury poisoning was in the Japanes Minamata Bay. Over 100 deaths occurred. The initial symptons were vague - fatigue, headache, irritability - and often went undetected. The mercury problem in this case grew out of industrial dumping.

Perhaps worse than that is the use of mercury as a fungicide and its concommitant release in the environment as an organic. The same argument can be used against lead. The lead tied up in the organic fragment used in gasolines presents the alarming problem of lead everywhere over the globe. Perhaps the newer cars operating without lead will reduce this danger.

Beryllim is 3 times as toxic as led. And with the new rocket research into cheaper fuels it has been discovered that a mixture of beryllium fibers with the fuel generates much more power. Is this another case where initial excitement spells later problems?

Asbestos is widely used and is becoming more so. The problems that it generates are due to it application and also to its mining and processing. There seems to be ways of cleaning up but the cost of cleaning seems greater than the cost of NOT doing so.

Solid wastes are generating many problems in the field of environmental concerns. As more and more is consummed there is more and more waste to get rid of. This is the mountains of waste that are carted off by the local garbage men. Charlotte disposes of several hundred tons of waste per day!!!

Recycling is a possible answer to the problems but this is a possibility that is full of many problems. The collection points as well the reprocessing plants are all problems that remain to be worked out.

Whether or not man solves these problems or as one writer puts it learns to live with the waste of his own creation is a question that at the present time is in grave doubt. There are some signs that man will succeed but others point to the old profit motive as the downfall of the system that has been built up so far. Only time will answer the questions of survival of slow rotting under the stagnating wastes of our own creation. If we adopt the philosophy "WE HAVE MET THE EMEMY AND HE IS US." we may have a chance.

BIOLOGY AND THE FUTURE OF MAN: Pesticides

The term pesticide is slightly misleading. It implies that all that is affected by the poisons are pests. In truth the whole life spectrum in an area is affected. Because of this the term biocide might be more applicable.

This paper will be divided into several different sections. One will cover the development of biocides, another will cover the major types in use today, a third will cover the effects of a particular biocide that has been a problem (perhaps as a portend of the future), and teh last section will deal wtih the perspectives for the future.

In the beginning the chemical company interested in the manufacture of a new biocide must undertake a exhaustive series of tests to determine those that posess a degree of biological activity. After the toxicity has been determined for a varied pest menangrie in the laboratory, the chemicals are aministered in differing dosages for long periods of time to determine long-term effects. Next if the chemical still seems good the chemical is let to an agricultural experimental stations generally these are run by the states or by the federal government. Then farmers are enlisted in the testing program to try the formulations on different crops, soils, climates, etc. If all these things are successful then the chemical can apply for a marketing permit. Even if granted testing continues to locate those chemicals with possible long range toxicity.

Cost of this program from start to finish is in the range of several millions of dollars. If the product is not marketable then none of the cost is recoverable. Is there a wonder that the chemical companies are in favor of less stringent regulation. The author of this paper has worked with the Dept. of health, Education, and Welfare and from the field testing involved

in biocide evaluation knows from personal knowledge that the program is heavily tilted to favor the chemical companies.

There are three major types of biocides in common usage today. These are the organophosphates - these are organic compounds that have phosphate molecules attached. These compounds work on the nervous system of the pests. While very toxic they do not last long in the environment (said not to be persistent); - chlorinated hydrocarbons are the second group of toxic substances. These are persistent and when used tend to remain in the system for a long period of time. The biocide DDT, discussed later in this paper is of this type. Again the nervous system seems to be affected; - carbamates are the third group of man-made chemicals use as pesticides. This group is just being developed and the effects are known only in the vaguest of terms.

One of the best ways to discuss biocide problems is to look at a particular biocide. DDT or dichloro-diphenyl-trichloro-ethane is the one biocide that has had more publicity than any other biocide in the history of biocides. The first DDT was made way back in 1874 by a German Ph.D. candidate named Zeidlar. He was not concerned with the killing properties of the material that he had synthesized; it remained for a Swiss named Muller owrking on insecticides in the 1930's to "discover" DDT. In 1942, some of this miracle stuff was brought to the U.S. where the military recognized the potential for the stuff. Thanks to DDT use WW II was the first war in history to have more fatalities attributable to wounds that to deaths attributed to insect borne diseases such as typhus, malaria, yellow fever, etc. After the war the U.S. and the Allies saved an estimated 5,000,000 lies by the use of DDT.

After DDT had been used for a time there began to develop strains of insects who were resistent to the sprays. More and more spray was necessary to achieve the same killing. The term used to rate the effectiveness of an insecticide is LD_{50} this stands for lethal dose to kill 50% of the insect population. As more and more spray was needed to maintain the LD at 50% other non-target species got hit and in many cases wiped out. Some mosquitoes developed such an affinity for DDT that this author has actually worked with a strain the REQUIRED DDT for survival. No DDT no mosquito. This is unusual but it speaks highly of the insect world's ability to adapt.

Since more and more DDT was used there was more and more in the environment. This went through an accumulation and build up in the food chain. This is where the smallest animal or plant ingests a small amount but the next largest animal eats a bunch on the smaller animals with their DDT resulting in the second animal with much more than the first; larger animals get more and still larger get MORE, etc. The animals thus mostly affected were those at the top of the food chain these were the meat eaters.

The following scenario describes the build-up but also speaks for the future.

* SCENARIO *

In a tropical village in Sumatra there was a mosquito problem the W.H.O. (World Health Organization) recommended a massive spray of DDT inside the adobe and straw huts to kill the mosquitoes. The spray killed the mosquitoes. In the process of spraying there were also worms in the thatch of the huts. These became sick and crawled out of the straw and where upon became the prey for birds waiting for a good and easy meal. The birds after having ingested the worms became ill and fell to the ground and began flopping around. The cats of the village came upon an easy meal of the sick

birds. The cats ate so many of these poisoned birds that they all died. After the cats died, the rate population began a population increase and with the rats came the fleas and with the fleas came the disease BUBONIC PLAGUE.

[end]

This is not a scenario in the true sense of the word because the incident described above actually is documented in W.H.O. records. Does this mean that as we attempt to fight one insect pest in the future that there will be others that take up the slack. It seems to be an unwritten law of nature that "NATURE ABHORES A VACUUM." This means that if one thing is removed there is another to take its place.

As more and more is learned perhaps we can turn to more ecologically sound methods of control. They do exist. All the scientists and the public have to do is to push for more research and then use of this research. Perhaps the ability to do genetic engineering might offer an excellent biological solution to this delimma. It seems that at the present time we are between the proverbial rock and the hard place.

THE FUTURE OF MAN

NAME_____

Cloning

1. The basic cell division process involved in cloning of cells is

   a. meiosis
   b. mitosis
   c. mitochondria
   d. sexual

2. The significance of cloning arises from the fact that each individual produced by sexual reproduction is

   a. exactly like one parent
   b. unqiue
   c. seldom completely formed
   d. often more like the female than the male parent

3. Cloning involves

   a. production of genetically identical cells
   b. stimulation of cells to grow outside the body
   c. a process only successful in plants
   d. both a and b are correct

4. One difficulty relating to cloning of human cells is their

   a. shape
   b. nucleus
   c. Tendency to stick together
   d. size

5. Cloning opportunities in the future might involve all the following EXCEPT

   a. production of particular good "crop" animals or plants with identical genetic makeup
   b. starting of "cell banks" which could hold cells for possible cloning for many years
   c. production of tissues from an individual's own body for use in repair of injuries such as burns
   d. determining the sex of an individual by amniocentesis during time in the uterus.

Amniocentesis and Sex Determination

6. Male humans have the chromosomal content

   a. XX, 46 autusomes
   b. XY, 46 autosomes
   c. XX, 44 autosomes
   d. XY, 44 autosomes

7. Amniocentesis involves

   a. removal of fluid from fetal placenta
   b. removal of fluid from amnionic sac
   c. determination of chromosomal makeup of fetus
   d. both b and c are correct

8. All of the following are chromosomal abnormalities that could be identified by amniocentesis and karyotyping except

   a. changes of genetic arrangement within a chromosome
   b. additional chromosomes
   c. missing chromosomes
   d. lost arms from chromosomes

9. Possible problems resulting from determination of sex before birth of infants might include

   a. increased pressure for proper care of expectant mothers
   b. decrease in use of contraceptives and increase in venereal disease
   c. increase in problems related to elective abortions
   d. there are no harmful results of knowing sex of infant, or if there are, the real harm has not been listed.

10. In the future difficulties may arise as quality of test methods improve and we are better able to detect

   a. time of conception
   b. hereditary abnormalities
   c. age of mother
   d. both a and b are correct

Look at the karyotype you have been given. Mark ALL letters below that apply to that set of chromosomes.

11. The ttached karyotype is

   a. normal male
   b normal female
   c. lacking one chromosome
   d. a trisomy
   e. male, abnormal
   f. female, abnormal

Prediction of Hereditary Abnormalities & Abortion

12. All of the following would be used to identify a condition as a hereditary disease EXCEPT

    a. occurrence of condition in many related individuals and not in those unrelated
    b. more occurrence among identical than fraternal twins
    c. identifyable abnormalities in the chromosomes of the individual
    d. no characteristic pattern of symptoms or time for onset

Match

13. prenatal diagnosis	a. currently available method of gaining information about possible hereditary disease
14. ultrasonic examination	
15. fetoscopy	b. currently available choice if couple knows that hereditary disease may be present in baby
16. artificial insemination	
17. amniocentesis	c. method of gaining information about possible hereditary disease available in the future only
18. termination of existing pregnancy	

Transplants

19. All of the following are current areas of transplant research and current transplantation EXCEPT

    a. skin
    b. liver
    c. heart valves
    d. heart

True-false

20. One large problem with transplants is that the body's own defense systems destroy transplanted tissue.

21. Currently drugs used to suppress rejection of new tissue can control rejection with no harmful side effects.

22. Long-term storage and banking of organs for transplants are currently available for use by doctors.

23. The trend for the future seems to involve replacement of worn or damaged organs by mechanical rather than natural organs.

24. Heart transplant patients currently live 15-20 years with transplanted organs.

Life-prolonging Machines

25. One of the most pressing problems involved in the use of life prolonging equipment is currently

    a. cost of providing equipment to all who need it
    b. decisions as to who should get the use of available equipment
    c. decisions as to when the use of such equipment should be started and stopped
    d. there are many pressing problems, all mentioned above might be correct.

26. Kidney dialysis equipment works using the principle of

    a. osmosis
    b. cyclosis
    c. mitosis
    d. diffusion

Match

27. heart-lung machine
28. computer
29. space flights
30. respirator

a. machine that later produced the respirator
b. linked to more effective development of life prolonging equipment
c. "spin offs" include sensors used in emergency facilities to monitor life functions
d. ultimately, long-term use results in damage to tissues in body

Cybernetics

31. All of the following would be types of cybernetic equipment <u>except</u>

    a. hearing aid
    b. transducer
    c. transplanted kidney
    d. prosthesis

32. Cybernetic devices usually have

    a. an outside-normal-body power source
    b. a use to replace or support existing body parts
    c. both a and b are correct
    d. there are no cybernetic devices in use yet

33. An example of a transducer would be

    a. a hearing aid
    b. a pacemaker
    c. a heart valve
    d. a little radio

True-false

34. Currently there are few people (less than 100,000) in the US who could effectively use cybernetic devices.

35. The trend for the future appears to indicate (barring wars, natural disasters) an increase in the people needing cybernetic devices.

36. A problem with attaching cybernetic equipment involves the way to attach wire to nerve.

37. Miniaturizing working parts and nuclear power will probably aid in future development of cybernetic parts.

38. Cybernetics and cryogenics are two terms involving the same technology.

Cryogenics

39. Currently cryogenics could be used for

    a. storage of sperms to be used in artificial insemination of cattle
    b. destruction of cells
    c. storing of entire human bodies for extended periods
    d. all of the above are correct

40. Currently about what % of cattle produced are the result of artificial insemination from cryogenically stored sperm (in the US)?

    a. 0%
    b. 25%
    c. 50%
    d. 100%

41. A future problem with cryogenics that must be overcome is that

    a. freezing tissue is easier than thawing it out without damage
    b. only plant materials can currently be frozen
    c. Sperms can be stored by this method but not eggs
    d. all the above are correct

42. In the future, the trends would indicate that the number of animals kept for "breeding stocks" will probably

    a. increase
    b. decrease
    c. fluctuate sidely
    d. remain unchanged

True-false

43. Cyrogenic effects can maintain or destroy animal tissue, depending on the circumstances.

44. In the future, refinements will probably be made in the current techniques for performing brain and other critical surgery using cryogenics.

Prenatal Surgery-Sperm and Egg Banks

45. Prenatal surgery is currently being done on human infants.

46. In the future, such operations as heart valve repairs could be done prenatally.

47. Major problems with prenatal surgery involve the sex of the infant.

48. Sperm and egg banks are currently being built up in the US.